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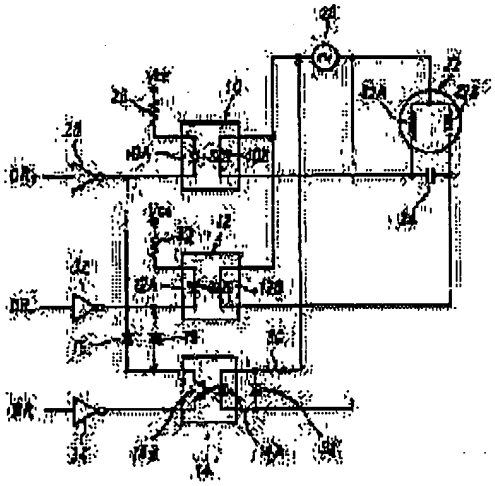
(54) CONTROL CIRCUIT FOR INDUCTION MOTOR

(57)Abstract:
PURPOSE: To provide a low-cost compact control circuit for an induction motor by eliminating the need for a special large capacity element used to supply braking current.
CONSTITUTION: The photo-TRIACs 10B, 12B of photo-couplers 10, 12 are connected in series with the primary windings 22A, 22B of an induction motor 22 to an AC power supply 20. When a forward-rotation control signal DR+ or a reverse-rotation signal DR- is at an H level, the photo-coupler 10 or 12 is turned on, the photo-TRIAC 10B or 12B is conducted, and ACs having phase difference by a capacitor 24 are made to flow through the primary windings 22A, 22B respectively, thus generating a revolving field in the forward direction or the opposite direction. When a braking control signal BR is at the H level, power supply voltage in the forward direction is applied to a light- emitting diode 14A for a photo-coupler 14 while both photo-TRIACs 10B, 12B are turned on simultaneously in each half cycle of polarity, and DCs are made to flow through the primary windings 22A, 22B, thus applying DC braking.



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* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1] The control circuit of the induction motor possessing the closing motion means of the bidirectional energization mold connected to the primary winding of an induction motor to AC power supply at the serial, and the braking control means which makes said closing motion means energize only by one polar half cycle in order to make said induction motor brake.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the control circuit which starts the control circuit of an induction motor, especially brakes by direct-current braking.
[0002]
[Description of the Prior Art] The conventional control circuit for condenser type single-phase induction motors is shown in drawing 6 . This control circuit is equipped with the triac 100,102 of the pair for forward inversion control, the thyristor 104 for braking control, and diode 110,112.
[0003] To AC power supply 106, the 1st and 2nd triacs 100,102 are connected with the 1st and 2nd primary windings 108A and 108B of an induction motor 108 at a serial, respectively, and the thyristor 104 is connected with both the primary windings 108A and 108B through diode 110,112 at the serial, respectively. As a thyristor 104 and diode 110,112 turn the same direction, i.e., each anode, to the primary-winding 108A and 108B side, they are connected.
[0004] Both the primary windings 108A and 108B are mutually connected to juxtaposition, and the capacitor 114 is connected to one terminal of AC power supply 106 with each terminal by which common connection is made between each terminals of the opposite side, i.e., each terminal by the side of a triac 100,102. Both the primary windings 108A and 108B are mutually arranged by the physical relationship of a right angle at the stator of an induction motor 108.
[0005] The 1st and 2nd triacs 100,102 are normal rotation control signal dr+ and the inversion control signal dr, respectively. - On-off control is carried out. The rotator of an induction motor 108 rotates in the forward direction by the rotating magnetic field of the forward direction which the 2nd triac 102 produces according to the phase contrast of the current which 1st primary-winding 108A by which direct continuation is carried out to the 1st triac 100 will operate as a main winding, and 2nd primary-winding 108B connected through a capacitor 114 will operate as auxiliary winding, and will flow to both the primary windings 108A and 108B, respectively if the 1st triac 100 turns on by the OFF state.
[0006] A rotator rotates to hard flow by the rotating magnetic field of the hard flow which the 1st triac 100 will produce according to the phase contrast of the current which 1st primary-winding 108A connected to a triac 102 through a capacitor 114 operates as auxiliary winding, and flows to both the primary windings 108B and 108A, respectively while 2nd primary-winding 108B by which direct continuation is carried out to the 2nd triac 102 operates as a main winding if the 2nd triac 102 turns on by the OFF state.
[0007] In order to apply braking, after turning all of the 1st and 2nd triacs 100,102 OFF, a thyristor 104 is turned ON with the braking control signal br. If it does so, only as for between a thyristor 104 and the half cycles by which forward voltage is impressed to diode 110,112, a current will flow to both the primary windings 108A and 108B at coincidence. Thus, a direct current flows every half cycle to a primary winding, when the secondary winding by the side of a rotator cuts the magnetic flux of the quiescence field which the direct current generates, electromotive force occurs in a secondary circuit and the secondary current flows. Since this secondary current generates force which bars relative motion with a field, it requires braking (brake) for a rotator.
[0008]
[Problem(s) to be Solved by the Invention] In the above-mentioned conventional induction motor control circuit, since a big direct current (about 4 times [at the time of operation] as many current as this) flowed to both the primary windings 108A and 108B of an induction motor 108 at the time of braking and this high current flowed also to a thyristor 104 through diode 110,112, a thyristor 104 and diode 110,112 had to be constituted from a mass rectifying device, the circuit was enlarged, and the equipment price was also attached highly.
[0009] This invention was made in view of this trouble, makes unnecessary the special mass rectifying device for passing a direct current at the time of braking, and aims at offering the control circuit of the induction motor which achieves a miniaturization and low-cost-izing of a circuit.
[0010]
[Means for Solving the Problem] A closing motion means of a bidirectional energization mold by which the control circuit of the induction motor of this invention was connected to the primary winding of an induction motor to AC power supply at the serial in order to attain the above-mentioned purpose, and the braking control means which makes said closing motion means energize only by one polar half cycle in order to make said induction motor brake were considered as the configuration in which it provides.
[0011]
[Function] In the control circuit of this invention, when performing operation actuation, and the closing motion means of a bidirectional energization mold will be in a closing (ON) condition continuously, the alternating current

from AC power supply flows to the primary winding of an induction motor through a closing motion means as it is, and the rotating magnetic field for rotating a rotator are formed. When performing braking actuation, and a braking control means makes a closing motion means energize only in one polar cycle and makes it a cut off state in the polar half cycle of another side, to the primary winding of an induction motor, the current of every half cycle flows as a direct current mostly, and direct-current braking is applied to a rotator by this direct current.

[0012]

[Example] Hereafter, the example of this invention is explained with reference to drawing 1 - drawing 5 .

[0013] Drawing 1 shows the configuration of the control circuit of the condenser type single-phase induction motor by the 1st example of this invention.

[0014] This control circuit has the photo couplers 10 and 12 of the photograph triac output mold of a pair in forward inversion control, and has the photo coupler 14 of one photo transistor output mold, and the diodes 16 and 18 of a pair in braking control.

[0015] To AC power supply 20, photograph triac 10B of a photo coupler 10 is connected to 1st primary-winding 22A of the condenser type single-phase induction motor 22, and a serial, and photograph triac 12B of a photo coupler 12 is connected to 2nd primary-winding 22B of an induction motor 22, and a serial. Both the primary windings 22A and 22B are mutually connected to juxtaposition, and the capacitor 24 is connected to one terminal of AC power supply 20 with each coil terminal by which common connection is made between each coil terminal by the side of each coil terminal of the opposite side, i.e., photograph triac 10B, and 12B. Both the primary windings 22A and 22B are mutually arranged by the physical relationship of a right angle at the stator of an induction motor 22. AC power supply 20 supplies the frequency of 50Hz, and the single-phase alternative current electrical potential difference of effective voltage 100V.

[0016] In the photo coupler 10, light emitting diode 10A of an input side is connected to the collector terminal of photo transistor 14B of a photo coupler 14 through diode 16 while an anode terminal is connected to DC power supply Vcc of 12V through resistance 26 and a cathode terminal is connected to the output terminal of an inverter circuit 28.

[0017] In the photo coupler 12, the anode terminal of luminescence anode 12A of an input side is connected to DC power supply Vcc through resistance 30, and the cathode terminal is connected to the collector terminal of photo transistor 14B through diode 18 while connecting with the output terminal of an inverter circuit 32.

[0018] In the photo coupler 14, the emitter terminal of photo transistor 14B of an output side is connected to the output terminal of an inverter circuit 34. Light emitting diode 14A of an input side is connected to AC power supply 20 through resistance 36. The diode 38 for protection is connected to this light emitting diode 14A and juxtaposition with the reverse sense.

[0019] Normal rotation control signal DR+ of binary level, inversion control signal DR-, and the braking control signal BR are inputted into inverter circuits 28, 32, and 34 from an operation sequencer circuit (not shown), respectively. Next, an operation of this control circuit is explained.

[0020] When rotating an induction motor 22 normally, it is normal rotation control signal DR+. Consider as H level and let other control signal DR- and BR be L level, When it does so, it is normal rotation control signal DR+. The output of an inverter circuit 28 is set to L for H level, in a photo coupler 10, light emitting diode 10A turns on and emits light, and photograph triac 10B is turned on with this light. On the other hand, it is the inversion control signal DR, - Since it is L level, the output of an inverter circuit 32 is H, in a photo coupler 12, light emitting diode 12A does not emit light, but photograph triac 10B is an OFF state. In a photo coupler 14, since the braking control signal BR is L level, the output of an inverter circuit 32 is H, even if photo transistor 14B of an output side receives light from light emitting diode 14A, it does not flow through it, therefore a current does not flow to diodes 16 and 18, either.

[0021] In this case, in an induction motor 22, 1st primary-winding 22A by which direct continuation is carried out to photograph triac 10B operates as a main winding, 2nd primary-winding 22B connected to photograph triac 10B through a capacitor 24 operates as auxiliary winding, and a rotator rotates in the forward direction by the rotating magnetic field of the forward direction produced according to the phase contrast of the current which flows to both the primary windings 22A and 22B, respectively.

[0022] When reversing an induction motor 22, it is the inversion control signal DR. - Consider as H level and let other control signal DR+ and BR be L level. Shortly, a rotator rotates to hard flow by the rotating magnetic field of the hard flow which a photo coupler 10 produces in an induction motor 22 by turning on the direction of a photo coupler 12 by the OFF state according to the phase contrast of the current which 2nd primary-winding 22B by which direct continuation is carried out to photograph triac 12B operates as a main winding, and 1st primary-winding 22A connected through a capacitor 24 operates as auxiliary winding, and flows to both the primary windings 22B and 22A, respectively.

[0023] When applying braking to an induction motor 22, the braking control signal BR is made into H level, and they are other control signal DR+ and DR. - It considers as L level. In this case, photo couplers 10 and 12 are normal rotation control signal DR+ and the reversal control signal DR, respectively, - It is not turned on. However, since the braking control signal BR is H level, the output voltage of an inverter circuit 34 is L level, and photo transistor 14B of a photo coupler 14 will be in the condition through which it can be flowed.

[0024] Therefore, when light emitting diode 14A emits light that is, photo transistor 14B flows during the period of each half cycle by which the alternating voltage from AC power supply 20 is impressed to light emitting diode 14A in the forward direction, and photo couplers 10 and 12 turn on in coincidence by this. That is, if photo transistor 14B flows, the current from the supply voltage terminal Vcc flows as collector current of photo transistor 14B through the light emitting diodes 10A and 12A and the joint diodes 16 and 18 of resistance 26 and 30 and photo couplers 10 and 12, respectively, in both the photo couplers 10 and 12, light emitting diodes 10A and 12A will emit light, and the photograph triacs 10B and 12B will be turned on following those light.

[0025] Thus, in while light emitting diode 14A emits light, during the period of each polar half cycle, both the photograph triacs 10B and 12B turn on in coincidence, and a current flows by this at coincidence to both the primary windings 22A and 22B of an induction motor 22. And since it does not flow through photo transistor 14B during the period of each polar half cycle of another side which light emitting diode 14A does not turn on, both the photograph triacs 10B and 12B of both are turned off. In addition, during the period of each polar half cycle of another side which light emitting diode 14A switches off, since the electrical potential difference of the forward direction is impressed by diode 38 and this turns on, light emitting diode 14A is protected from the excessive reverse bias.

[0026] Thus, in an induction motor 22, when the half wave current of every half cycle flows as a current of a direct current to primary windings 22A and 22B, a quiescence field occurs, electromotive force occurs in the secondary winding by the side of the rotator which cuts the magnetic flux of this quiescence field, and braking (brake) starts a rotator by the electromagnetic interaction of the secondary current and a field.

[0027] As described above, in the control circuit of the induction motor in this example The alternating current for making a triac (10 12) energize by the half cycle of amphipathy, and building rotating magnetic field to the primary winding (22A, 22B) of an induction motor 22, when performing operation (normal rotation/inversion) actuation A sink, When braking, he is trying to pass the direct current for making a triac (10 12) energize only by one polar half cycle, and causing direct-current braking to the primary winding (22A, 22B) of an induction motor 22.

[0028] Thus, by making the triac for operation controls (10 12) connected to a primary winding (20A, 20B) and a serial energize only by half cycle of one of the two at the time of braking Since the half wave current of every half cycle was passed as a direct current to the primary winding (20A, 20B), mass rectifying devices formed in direct-current braking in the conventional control circuit, such as a thyristor (104) and diode (110,112), are unnecessary in the control circuit of this example. Moreover, since photo couplers 10, 12, and 14 have separated electrically the control section (weak-electric-current circuit section) for carrying out change-over control of the triac (10 12), a small capacitative element (especially diode 16, 18 grades) can be used for a control section. For this reason, a control board can be miniaturized sharply and cost can also be lowered sharply.

[0029] Drawing 2 shows the configuration of the control circuit of the condenser type single-phase induction motor by the 2nd example. The same sign is given to the part which is common in the 1st example (drawing 1) of the above among drawing.

[0030] In the control circuit by the 1st example of the above, this control circuit generates the braking control signal BR automatically in a circuit, and is made to perform direct-current braking immediately after operation termination while it also combines control of the electromagnetic brake attached to an induction motor 22 and is made to perform it.

[0031] In drawing 2 , photograph triac 40B of a photo coupler 40 is connected to primary-winding 42A of the deenergisation actuation mold electromagnetic brake 42, and a serial to AC power supply 20. Actuation association is carried out at the stator of an induction motor 22, and if a mechanical brake will be canceled by the electromagnetic force (disable) and an exciting current will not flow while the exciting current is flowing to primary-winding 42A, electromagnetic brake 42 will operate a mechanical brake (enable), and will apply brakes to the stator of an induction motor 22.

[0032] An anode terminal is connected to the terminal of supply voltage Vcc through resistance 44, and, as for light emitting diode 40A of a photo coupler 40, the cathode terminal is connected to the output terminal of an inverter circuit 46. Common connection of the cathode terminal of diodes 48 and 50 is made at the input terminal of an inverter circuit 46, and the anode terminal of diodes 48 and 50 is connected to the input terminal of inverter circuits 28 and 32, respectively. The output terminal of an inverter circuit 46 is connected to the input terminal of an inverter circuit 34 through the time constant circuit which consists of a capacitor 52 and resistance 54. The diode 56 which turned the cathode terminal to the input terminal of an inverter circuit 34, and was connected to resistance 54 and juxtaposition is the diode for a clamp.

[0033] In this configuration, the circuit which controls actuation of electromagnetic brake 42 by diodes 48 and 50, the inverter circuit 46, and the photo coupler 40 is constituted, and the circuit which generates the braking control signal BR by diodes 48 and 50, the inverter circuit 46, and the time constant circuit (52 54) is constituted.

[0034] Next, the operation in this example is explained with reference to the timing chart of drawing 3 .

[0035] Normal rotation control signal DR+ While maintaining H level, as described above, photograph triac 10B of a photo coupler 10 is turned on, and, as for the induction motor 22, rotation actuation of the forward direction is performed, the output voltage of during this period and an inverter circuit 46 — L level — it is — electromagnetism — ON state, i.e., light emitting diode, 40A emits light, photograph triac 40B is turned on, an exciting current flows to primary-winding 42A of the no-load actuation mold electromagnetic brake 42, and the photo coupler 40 for PUREKI control is controlling the brake to an induction motor 22. Moreover, the input voltage of an inverter circuit 34 is L level, output voltage is H level, and the photo coupler 14 for braking control is turned off.

[0036] It is normal rotation control signal DR+ in order to stop rotation actuation of an induction motor 22. For example, time of day t0 If it is made L level, the output voltage of an inverter circuit 46 will be reversed on H level. this — electromagnetism — the photo coupler 40 for PUREKI control will be in an OFF state, photograph triac 40B will intercept, an exciting current will not flow to primary-winding 42A of electromagnetic brake 42, and the mechanical brakes from electromagnetic brake 42 are applied to the rotator of an induction motor 22.

[0037] On the other hand, if the output voltage of an inverter circuit 46 is set to H level, through a capacitor 52, the input voltage of an inverter circuit 34 will also start on H level, and the output voltage of an inverter circuit 34 will fall to L level ((C) of drawing 3 , and (D)). And it is output voltage BR till the time (time of day t1) of the input voltage of an inverter circuit 34 falling exponentially in an operation of a time constant circuit (52 54), and reaching a threshold Vth. - The condition of L level is maintained. During this period TO (t0 -t1), the photo coupler 14 for braking control is turned on, and they are (E) of drawing 3 , and (F) by the same operation as the 1st example of the

above. So that it may be shown When both the photograph triacs 10B and 12B flow in coincidence in one polar half cycle of each, a direct current of a half wave flows to both the primary windings 22A and 22B of an induction motor 22, and direct-current braking is applied.

[0038] Thus, normal rotation control signal DR+ If it cuts, automatically, direct-current braking will be applied within an induction motor 22 at the same time the external electromagnetic brake 42 operates, and an induction motor 22 will stop in an instant. In addition, although the example of drawing 3 was the case where normal rotation actuation was stopped, even when inversion actuation is stopped, same braking actuation is performed.

[0039] Drawing 4 shows the example which applied the induction motor control circuit by the 2nd above-mentioned example to the ambient atmosphere shutter equipment of the washing system in a semi-conductor production process.

[0040] In this kind of washing system, while various washing processing tubs are arranged to a single tier and a carrier robot grasps a processed object, for example, a semi-conductor wafer, with a conveyance arm etc., it is made to carry out sequential migration of those washing processing tubs, but since it is pretreatment of micro processing anyway, it is desirable to intercept each ambient atmosphere mutually between ****** washing processing tubs from a viewpoint of process tolerance or the yield. Therefore, a positive damping characteristic with ambient atmosphere shutter equipment stable not to mention shutter speed is required. Furthermore, since it is installed in a clean room, a thing of small size, especially narrow size is desired.

[0041] when it is installed between ****** washing processing tubs, the shutter plate 60 has always closed and it lets a processed object pass, shutter 60 plate opens the ambient atmosphere shutter equipment in this example (it falls) — it is like. The shutter control section and the mechanical component are held in the case 62 of the upper part location of the shutter plate 60. The revolving shaft of an induction motor 22 is connected to the pulley 66 through the derailleur in a gearbox 64, and the driving belt 68 is hung on this pulley 66. The shutter plate 60 is combined with this driving belt 68 through joint in shutter receipt and the interior 70 of a proposal, the rotation driving force of an induction motor 22 is changed into straight-line driving force by the driving belt 68, and the shutter plate 68 carries out rise-and-fall migration at a driving belt 68 and one.

[0042] Within the case 62, electromagnetic brake 40 is attached behind the induction motor 22 at one, and the control box 72 for controlling an induction motor 22 and electromagnetic brake 40 is established in the back. In this control box 72, the primary windings 22A and 22B of an induction motor 22 and all the circuits except primary-winding 42A of electromagnetic brake 42, i.e., the control circuit of this example, are held in drawing 2 .

[0043] When it came by this ambient atmosphere shutter equipment before the predetermined location which the shutter plate 60 should stop at the time of shutter closing motion, it is operation control signal DR+, Or DR - It is cut, and when electromagnetic brake and direct-current braking act on an induction motor 22 as mentioned above at coincidence, the shutter plate 60 stops promptly in a predetermined location. Moreover, since the special mass energization component for direct-current braking is not prepared, a control box 72 is miniaturized and a case 62 thru/or the whole equipment are also miniaturized.

[0044] Drawing 5 shows the configuration of the control circuit of the condenser type single-phase induction motor by the 3rd example of this invention. The same sign is given to the part which is common in the 1st and 2nd examples (drawing 1 and drawing 2) of the above among drawing.

[0045] The triacs 80 and 82 ordinary as a bidirectional energization mold component connected to the primary windings 22A and 22B of an induction motor 22 and a serial are used for this 3rd example. While connecting with the emitter terminal of NPN transistors 84 and 86 emitter-grounded, respectively, common connection of the control terminal (trigger terminal) of the 1st and 2nd triacs 80 is made through diodes 88 and 90 at the emitter terminal of NPN transistor 92. In the base terminal of NPN transistors 84, 86, and 92, they are normal rotation control signal DR+ of binary level, and the inversion control signal DR, respectively. - And the braking control signal BR is inputted. The collector terminal of NPN transistor 92 is connected to the terminal of supply voltage Vcc through photo transistor 14B of a photo coupler 14, and resistance 94.

[0046] According to this configuration, when performing normal rotation actuation, the 2nd triac 82 becomes [the 1st triac 80] off by ON continuously, when performing inversion actuation, the 1st triac 80 is continuously off and the 2nd triac 82 serves as ON continuously. When braking, both the triacs 80 and 82 turn on in coincidence only by one polar half cycle, and become off in the polar half cycle of another side at coincidence.

[0047] In the above-mentioned 1st - the 3rd above-mentioned example, generally, although the thing of a zero cross mold through which it flows from the zero crossing point of a current is desirable, even if the triac connected to the primary winding of an induction motor and a serial is not the thing of a zero cross mold, it is possible. Moreover, it is also possible for desired phase lag to be given to the flowing point of TORAAKKU, and for it to be made to carry out adjustable setting of the direct-current damping force to it. Moreover, it is possible to replace with a triac and to use other bidirectional energization mold closing motion components or keying circuits.

[0048] The thing of for example, not only the thing of a photo transistor output mold but a photograph MOS output mold is sufficient as the photo coupler for braking control, it may be further replaced with a photo coupler and a transformer may be used for it.

[0049] Although the above-mentioned example started the condenser type single-phase induction motor, the braking control means or method of this invention is applicable also to other single-phase induction motors and three-phase induction motors of form.

[0050]

[Effect of the Invention] Since a sink and direct-current braking were applied to the primary winding for the direct current by making the closing motion means of the bidirectional energization mold connected to the primary winding of an induction motor, and a serial energize only in the direction of one side at the time of braking according to the control circuit of the induction motor by this invention as explained above, the special mass rectifying device for direct-current braking is unnecessary, and a large miniaturization and low-cost-izing of a circuit can be realized.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the circuit diagram showing the circuitry of the control circuit of the condenser type single-phase induction motor by the 1st example of this invention.
[Drawing 2] It is the circuit diagram showing the circuitry of the control circuit of the condenser type single-phase induction motor by the 2nd example.
[Drawing 3] It is the timing chart showing the electrical potential difference or current wave form of each part for explaining the operation in the 2nd example.
[Drawing 4] It is the abbreviation perspective view showing the configuration of the ambient atmosphere shutter equipment of the washing system which applied the control circuit of the induction motor by the 2nd example.
[Drawing 5] It is the circuit diagram showing the circuitry of the control circuit of the condenser type single-phase induction motor by the 3rd example.
[Drawing 6] It is the circuit diagram showing the configuration of the conventional control circuit for condenser type single-phase induction motors.
[Description of Notations]
10, 12, 14 Photo coupler
10A, 12A, 14A Light emitting diode
10B, 12B Photograph triac
14B Photo transistor
16 18 Diode
20 AC Power Supply
22 Induction Motor
22A, 22B Primary winding
48 50 Diode
52 Capacitor
54 Resistance

[Translation done.]